NON-PUBLIC?: N
ACCESSION #: 9510030190
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Arkansas Nuclear One - Unit 2 PAGE: 1 OF 5

DOCKET NUMBER: 05000368

TITLE: AUTOMATIC REACTOR TRIP ON HIGH AXIAL SHAPE INDEX DURING STARTUP DUE TO INADEQUATE MONITORING AND ACTION TO MAINTAIN EXCORE POWER BELOW THE CORE PROTECTION CALCULATOR TRIP ENABLE SETPOINT
EVENT DATE: 09/02/95 LER #: 95-003-00 REPORT DATE: 09/27/95

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 17

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
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COMPONENT FAILURE DESCRIPTION:
CAUSE: SYSTEM: COMPONENT: MANUFACTURER:
REPORTABLE NPRDS:

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

During plant startup from a reactor trip on the previous day, an automatic reactor trip occurred on September 2, 1995, when power exceeded 17 percent raw excore power (average) and enabled the auxiliary Core Protection Calculator (CPC) trip on Axial Shape Index (ASI) with ASI in excess of the trip setpoint. The trip was uncomplicated with all safety systems responding as expected for plant conditions. ASI is the power generated in the lower half of the core less the power generated in the upper half of the core divided by the sum of these powers. The root cause of this event was attributed to personnel error on the part of the licensed operator who was assigned to monitor and control reactor power. There were several contributing factors, including feedwater and steam generator water level oscillations that diverted attention to the secondary side of the plant. ANO-2 Operations management provided lessons learned from this event to ANO-2 Senior Reactor Operators, including Shift Superintendents who then discussed it with their respective crews. The procedure used for startup has been revised to include a specific hold point at approximately 10 percent power to ensure that ASI is below the trip setpoint.

END OF ABSTRACT

A. Plant Status

At the time of this event, Arkansas Nuclear One Unit 2 (ANO-2) was

operating at approximately 17 percent raw excore power (average) with plant startup in progress from a reactor trip that had occurred on the previous day. The reactor was near the end of core life, approximately three weeks before the start of a scheduled refueling outage. High levels of xenon present in the core were being reduced by burnout and decay.

B. Event Description

On September 2, 1995, ANO-2 experienced an automatic reactor trip when raw excore average reactor power exceeded 17 percent and enabled the Axial Shape Index (ASI) trip with ASI in excess of its trip setpoint.

At ANO-2, the Core Protection Calculator (CPC) JC! system consists of four computers that monitor various plant parameters and generate trip signals when Departure from Nucleate Boiling Ratio (DNBR) and Local Power Density (LPD) setpoints are exceeded. A particular combination of input parameters has been defined within which the CPCs are valid. Beyond this normal operating range, calculations are inaccurate or the look-up table values are invalid. For this reason, operation of the CPCs outside of this parameter space will result in an automatic reactor trip for the affected channel(s). This trip takes the form of low DNBR and high LPD channel trip contacts opening. Tripping the CPCs in this manner is known as an "auxiliary trip", since the trip does not result from detailed DNBR or LPD calculations. One of the parameters that cause an auxiliary trip is ASI. ASI is defined as the power generated in the lower half of the core less the power generated in the upper half of the core divided by the sum of these powers. The core axial power

distribution is calculated using inputs from excore nuclear instrumentation with the application of appropriate correction factors. The auxiliary trip on ASI is enabled at 17 percent power increasing, as calculated from the average of raw neutron flux power from three excore detectors in each channel, and will generate a trip signal when ASI exceeds the limits of 0.5. When power decreases to less than 14.5 percent, the auxiliary trip on ASI is removed from the protection scheme.

Prior to assuming duties for the evening shift, the on-coming Operations crew received a briefing on power ascension and discussed individual watch stander responsibilities. Two additional licensed operators were assigned to the Control Room to allow concentration of effort in specific areas. The effects of xenon burnout and decay, as well as ASI control, were discussed. The Control Room Supervisor (CRS) addressed the concern with approaching the CPC channel

average raw excore power level of 17 percent with ASI near the trip setpoint. No specific strategy was discussed for managing this condition other than leveling power at approximately 14 percent using CPC channel calibrated power if indicated ASI remained outside the CPC trip setpoint. The Control Board Operator Reactor (CBOR) was tasked with maintaining power at this level until ASI was at least -0.4 or less negative. The lack of crew experience with startups complicated by xenon was also addressed. Operations management and crew expectations regarding focus on watch station assignments and proper communications were emphasized. Reactor

power was stabilized at approximately 2 percent during crew turnover.

Because of expectations that ASI would become less negative during power ascension and anticipated difficulty with controlling steam generator water levels at low power, a crew decision was made to reevaluate ASI above 10 percent power and hold power at 14 percent until ASI was below the trip setpoint if necessary. The crew was in the process of stabilizing power at approximately 13 percent. Due to feedwater oscillations causing steam generator AB! level swings, spiking main condenser SG! pressure alarms, and a leak on a Main Feedwater SJ! regulating valve, attention of the CRS and CBOR was being diverted toward the secondary side of the plant. Power level was being monitored using calibrated power from CPC channel "N' (a more accurate indication of reactor power) and raw power from CPC channel "C". During the existing core conditions, the calibrated power may read as much as 4 percent lower than the average raw power outputs of each channel's three excore detectors. Also, the average of these three values from which the ASI trip is generated is not programmed or available for display in the Control Room. It must be manually calculated by the operator in order to evaluate proximity to the CPC trip enable setpoint. Just prior to the trip, CPC channel "A" was indicating approximately 13 percent and CPC channel "C" raw power was averaging 16.2 percent. At this point, the CRS and Control Room watch team had become focused on dampening steam generator level swings. Believing reactor power to be stable, the CRS directed the CBOR to regain margin to the trip enable setpoint by borating. ASI was indicating -0.7. At 1927 hours, Reactor Protection System (RPS) JC! channel "C" received trips on low DNBR and high LPD followed six seconds later by trips on channel "D".

Two of the 4 CPC channels reaching the point of enabling the ASI trip with ASI greater than the setpoint resulted in a reactor trip. Standard post-trip actions were taken and, following confirmation of no complications, the plant was stabilized in accordance with the procedure for trip recovery.

After the transient review was completed, the reactor was critical at 1011 and the main turbine generator placed on-line at 2146 on September 3, 1995.

C. Root Cause

The root cause of this event is attributed to personnel error on the part of licensed operators. Both the CRS and CBOR failed to adequately monitor CPC channel raw excore power and take effective or appropriate corrective action prior to reactor power reaching the ASI trip enable setpoint. A Human Performance Evaluation performed for this event identified the failure of the CBOR to maintain CPC raw average excore power below limits established by the CRS as the specific "inappropriate action."

There were several factors that contributed to this event. Due to the exceptional operating performance for ANO-2 over the past several years, Control Room personnel involved in this event had limited opportunities for experience with actual plant startups under these conditions. Furthermore, the operators' training on the unit simulator for similar plant conditions led them to believe that the response for transient ASI would not have been as rapid as was

actually observed during the startup on September 2, 1995,

Control Room operators allowed themselves to be distracted by the difficulties in maintaining steam generator levels in manual feedwater control. Since the most difficult control region for manual feedwater operation occurs between 5 and 10 percent power, this influenced the decision to stabilize power around 14 percent rather at a lower level with an improved margin to the ASI trip enable.

The mental calculations required of the operator to determine the average CPC channel raw excore power were an added distraction

The procedure for the startup provided a broad latitude for the decision to hold power at any level below the ASI trip setpoint with the exact level left to the discretion of the operator.

D. Corrective Actions

ANO-2 Operations Management discussed lessons learned from this event with Unit 2 Senior Reactor Operators including Shift Superintendents. The Shift Superintendents have discussed the event with their respective crews.

The procedure for startup was modified to include a specific hold point requiring stabilizing power at approximately 10 percent until ASI is verified to be less than the trip setpoint.

Improvements in the ANO-2 plant simulator model for transient ASI will be evaluated and implemented, as appropriate, by June 1, 1996.

Computer points for CPC channel average raw excore power will be added to the Plant Monitoring System computer by April 15, 1996.

E. Safety Significance

The CPCs initiated a reactor trip at the desired setpoint. The trip was uncomplicated with all systems responding as expected for plant conditions. There were no Engineered Safety Features JE! actuations. All CEAs fully inserted. Steam generator water levels were maintained in the normal control band with Auxiliary Feedwater BA!. Immediate operator actions were accomplished with no difficulties. Therefore, this event is considered to be of minimal safety significance.

F. Basis for Reportability

This event involved the automatic actuation of the RPS that is reportable pursuant to 10CFR50.73(a)(2)(iv). It was reported to the NRC Operations Center at 2005 on September 2, 1995, as required by 10CFR50.72(b)(2)(ii).

G. Additional Information

ANO-2 reported automatic reactor trips due to ASI limits being exceeded during plant startup in Licensee Event Report (LER) 50-368/84-027-00 and 50-368/85-005-00. ASI control problems resulted in a reactor trip during shutdown that was reported in LER

50-368/86-009-00. Since these events did not involve the same root cause or sequence of events, they are not considered to constitute previous similar events.

Energy Industry Identification System (EIIS) codes are identified in the text as xx!.

ATTACHMENT TO 9510030190 PAGE 1 OF 2

ENTERGY Entergy Operations, Inc.
(illegible print)
Russellville, AR 72801
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September 27, 1995

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U. S. Nuclear Regulatory Commission
Document Control Desk
Mail Station P1-137
Washington, DC 20555

Subject: Arkansas Nuclear One - Unit 2
Docket No. 50-368
License No. NPF-6
Licensee Event Report 50-368/95-003-00

Gentlemen:

In accordance with 10CFR50.73(a)(2)(iv), enclosed is the subject report concerning an automatic reactor trip.

Very truly yours,

Dwight C. Mims
Director, Licensing

DCM/tfs

enclosure

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